MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
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SRM Number: 3116a
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SRM Name: Erbium Standard Solution

Date of Issue: 02 June 2006

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of erbium. One unit of SRM 3116a consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of erbium. The solution contains nitric acid at a volume fraction of approximately 10 %.

Material Name: Erbium Standard Solution

Other Designations:

Erbium: Er; elemental erbium
Erbium Nitrate Pentahydrate: erbium trinitrate pentahydrate; nitric acid erbium (3+) salt pentahydrate.
Nitric Acid: Aqua fortis; hydronitrate; azotic acid; engraver's acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Nitric Acid	7697-37-2	231-714-2	10
Erbium Nitrate Pentahydrate	10031-51-3	233-436-7 [anhydrous]	2.7
Erbium	7440-52-0	231-160-1	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 4 Fire = 0 Reactivity = 2

Major Health Hazards: Nitric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. Erbium and erbium nitrate may irritate the skin, eyes, and respiratory tract, and may damage the liver or other organs.

Physical Hazards: Glass container may break or shatter.

Potential Health Effects

Inhalation: Nitric acid can damage the mucous membranes and respiratory tract, causing spasm, inflammation of the larynx and bronchi, chemical pneumonitis, and pulmonary edema. Symptoms may include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Teeth may also be damaged. Inhalation of erbium or erbium nitrate may irritate the respiratory tract; other effects may include itching, sensitivity to heat, and an increased awareness of odor and taste. Some rare earth elements and compounds may cause lung granulomas.

Skin Contact: Nitric acid can cause severe skin burns. Effects of acid burns may be delayed. Skin contact with erbium or its compounds may cause skin irritation. If skin is abraded, hair loss and scar formation may result.

Eye Contact: Nitric acid can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Erbium and erbium nitrate may cause eye irritation.

Ingestion: Nitric acid can cause severe burns and damage to the GI tract. The oral toxicity of erbium is expected to be low due to poor absorption. The toxicity of erbium nitrate has not been fully investigated, but repeated or prolonged exposure to nitrates in general may cause anemia and kidney disease. These compounds are also likely to irritate the GI tract, causing abdominal pain, nausea, and/or diarrhea. Liver damage may occur, and blood clotting time may be affected.

Medical Conditions Aggravated by Exposure: Pre-existing disorders of the eyes, skin, respiratory tract, GI tract, or other target organs; hemophilia, anticoagulant therapy, or other conditions that interfere with blood clotting.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

Note to Physician (Nitric Acid): Wash affected skin with 5% solution of sodium bicarbonate ($NaHCO_2$). Activated charcoal is of no value. Do not give bicarbonate to neutralize the material.

5. Fire Fighting Measures

Fire and Explosion Hazards: Nitric acid is a powerful oxidizing agent that can react with combustible materials to cause fires. Erbium nitrate is also an oxidizer. No data are available for the mixture, and its behavior may differ from that of the individual components.

Extinguishing Media: Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute nitric acid and to absorb liberated oxides of nitrogen. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. Accidental Release Measures

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction.

Disposal: Refer to Section 13, Disposal Considerations.

7. Handling and Storage

Storage: Store unopened containers of this material in a dry place at room temperature. Protect from physical damage, heat, and light, and isolate from incompatible materials. Use opened containers immediately or discard.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). If contact with this material occurs, wash hands or change clothing as required. Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. Exposure Controls and Personal Protection

Nitric Acid:

ACGIH TLV-TWA: 2 ppm or 5 mg/m^3
OSHA TLV-TWA: 2 ppm or 5 mg/m^3
UK WEL: 5.2 mg/m^3

Erbium Nitrate Pentahydrate:

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m^3; respirable dust, 5 mg/m^3
ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m^3; respirable dust, 3 mg/m^3
UK WEL: None established. Total inhalable dust, 10 mg/m^3; respirable dust, 4 mg/m^3

Erbium:

OSHA TLV-TWA: None established. Total nuisance dust, 15 mg/m^3; respirable dust, 5 mg/m^3
ACGIH TLV-TWA: None established. Total nuisance dust, 10 mg/m^3; respirable dust, 3 mg/m^3
UK WEL: None established. Total inhalable dust, 10 mg/m^3; respirable dust, 4 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Nitric Acid	Erbium Nitrate Pentahydrate	Erbium
Appearance and Odor: Colorless to slightly yellow liquid, darkens to brown upon aging and exposure to light; irritating, pungent odor.	**Appearance and Odor:** Large, reddish crystals; no odor	**Appearance and Odor:** Soft, bright gray metal or dark gray powder, no odor
Relative Molecular Weight: 63.02	**Relative Molecular Weight:** 443.35	**Relative Molecular Weight:** 167.26
Molecular Formula: HNO_3	**Molecular Formula:** $Er(NO_3)_3{\cdot}5H_2O$	**Molecular Formula:** Er
Specific Gravity: 1.0543 (10%)	**Specific Gravity:** N/A	**Specific Gravity:** 9.1
Solvent Solubility: Decomposes in alcohol	**Solvent Solubility:** Soluble in acetone, alcohol, ether	**Solvent Solubility:** Soluble in acids
Water Solubility: Soluble	**Water Solubility:** Soluble	**Water Solubility:** Insoluble
Boiling Point (ºC): 86 (187°F)	**Boiling Point (ºC):** N/A	**Boiling Point (ºC):** 2510 (4550ºF)
Melting Point (ºC): -42 (-43.6°F)	**Melting Point (ºC):** 130 (266ºF), loses water	**Melting Point (ºC):** 1522 (2772ºF)
Vapor Pressure (Pa): 946 @20°C	**Vapor Pressure (Pa):** Negligible	**Vapor Pressure (Pa):** Negligible
Vapor Density (Air=1): 2.17	**Vapor Density (Air=1):** 15.29	**Vapor Density (Air=1):** N/A
Critical Solution Temperature: N/A	**Critical Solution Temperature:** N/A	**Critical Solution Temperature:** N/A
pH: 1.0 (0.1M solution)	**pH:** N/A	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this solution do not exist. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Incompatible materials, combustible materials, heat, ignition sources, mechanical shock.

Incompatible Materials:

Nitric Acid: Incompatible with numerous materials including organic materials, plastics, rubber, chlorine, and metal ferrocyanide.

Erbium Nitrate Pentahydrate: Incompatible with metals, combustible materials, metal salts, sulfur, phosphorus, acids, and reducing agents.

Erbium: Incompatible with strong oxidizers and acids, halogens, moisture, and air.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of this material may produce oxides of nitrogen and erbium.

Hazardous Polymerization: _____ Will Occur __X__Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Nitric Acid:

Human, oral: LD_{Lo} = 430 mg/kg
Rat, oral: LD_{50} > 90 mg/kg
Rat, inhalation: LC_{50} (4 hrs) = 130 mg/m^3

Erbium Nitrate Pentahydrate:

Rat, intravenous: LD_{50} = 30 mg/kg
Rat, intraperitoneal: LD_{50} = 230 mg/kg
Mouse, intraperitoneal: LD_{50} = 225 mg/kg

Erbium:

Rat, intraperitoneal: LD_{50} = 535 mg/kg
Rat, oral: LD_{50} = 6200 mg/kg

Target Organ(s): Respiratory tract, skin, eyes, GI tract, bone marrow, liver.

Mutagen/Teratogen: Nitric acid has caused birth defects in animals under experimental conditions, and has also been investigated as a possible mutagen. Erbium and its compounds are not known to be reproductive hazards, but their toxicity has not been fully investigated.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Nitric Acid, Ecotoxicity Data:

Green shore crab (*Carcinus maenas*): LC_{50} (48 hrs) = 180,000 µg/L
Starfish (*Asterias rubens*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Hooknose (*Agonus cataphractus*): LC_{50} (48 hrs) = 100,000 to 330,000 µg/L
Brook trout (*Salvelinus fontinalis*): NR-LETH = 1,562 µg/L
Cockle (*Cerastoderma edule*): LC_{50} (48 hrs) = 330,000 to 1,000,000 µg/L

Erbium Nitrate Pentahydrate: No ecotoxicity data found. Soluble salts of some other rare earth metals (such as lanthanum) are toxic to fish.

Erbium: No ecotoxicity data found.

Environmental Summary: At least one component of this mixture (nitric acid) is toxic to aquatic organisms. Do not release to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture are a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: Nitric Acid Solution, Hazard Class 8, UN2031, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Nitric Acid: RQ = 1000 lb.
Erbium Nitrate: Not regulated.
Erbium: Not regulated.

SARA Title III Section 302: Nitric acid is regulated.

SARA Title III Section 304: Nitric acid is regulated.

SARA Title III Section 313: Nitric acid and dysprosium nitrate are regulated.

OSHA Process Safety (29 CFR 1910.119): Nitric acid at higher concentrations ($\geq$ 94.5%) is regulated.

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: None of the components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Nitric Acid: C (oxidizing material), D1A (very toxic material), E (corrosive material)
Erbium Nitrate: C (oxidizing material)
Erbium: D2B (toxic material)

WHMIS Ingredient Disclosure List: Nitric acid is regulated.

CEPA Domestic Substances List (DSL): Nitric acid is regulated.

CEPA Non-Domestic Substances List (NDSL): Erbium is regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Nitric Acid: O (Oxidizer), C (Corrosive)
Erbium Nitrate: O (Oxidizer); not classified in Annex I of Directive 67/548/EEC
Erbium: Xn (Harmful), Xi (Irritant); not classified in Annex I of Directive 67/548/EEC

Risk Phrases (mixture):

R23 (toxic by inhalation)
R25 (toxic if swallowed)
R34 (causes burns)
R36/37/38 (irritating to eyes, respiratory system and skin)

Safety Phrases (mixture):

S20/21 (when using, do not eat, drink or smoke)
S28 (wash after contact with skin)
S45 (in case of accident or illness, see doctor; show label)
S60 (dispose of this material and its container as hazardous waste)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: None of the components are listed.

16. OTHER INFORMATION

Sources:

Haley TJ, Pharmacology and toxicology of the rare earth elements. *Journal of Pharmaceutical Sciences* 1965; 54(5):663-670.

IUCLID Dataset: Nitric Acid. European Commission, European Chemicals Bureau, 19 February 2000.

PAN Pesticide Database: Nitric Acid.

TERA, Development of Reference Doses and Reference Concentrations for Lanthanides. U.S. Bureau of Land Management, November 1999.

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, September 2005 edition. DHHS (NIOSH) Publication No. 2005-151.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.